Water Hist (2013) 5:173–194
DOI 10.1007/s12685-013-0077-z

Floods, fights and a fluid river: the Viennese Danube in the sixteenth century

Christoph Sonnlechner · Severin Hohensinner · Gertrud Haidvogl

Received: 25 September 2012 / Accepted: 25 March 2013

Abstract Alluvial rivers can show unpredictable channel changes and humans living along the river corridor repeatedly have to cope with the alterations of their physical environment. This was specifically the case in the mid-sixteenth century, when the Viennese were confronted with one major problem: the Danube River successively abandoned its main arm that ran close to the city and shifted further north. This was at the time when Vienna became the permanent residence of the Holy Roman Empire (except from 1583 to 1611 when it was moved to Prague), due to the Habsburgs holding the crown. Vienna was also the capital of the so-called Danube Monarchy, which came into being in the early sixteenth century. The city assumed increasing significance, being home to and hosting important authorities and persons. In particular after the first siege by the Ottoman army in 1529, the resource need for a complex fortification system was extremely high. This paper aims to highlight: (1) the morphological Danube dynamics together with floods and extreme weather situations in the sixteenth century; (2) the main actors in the transformation of the Danube; (3) changes of the river's course from 1550 to 1600/1650 and the consequences for bridging the river and the infrastructure as a whole; (4) the massive engineering measures that were undertaken in order to secure Vienna's requirements in the sixteenth century; (5) the question of floodplain settlements, and (6) the contested use of resources on the Viennese Danube floodplain.

Keywords Regulation · Resources · River morphology · Stakeholders · Floodplain · Vienna · Danube

C. Sonnlechner (✉)
City Archives of Vienna, 1082 Vienna, Austria
e-mail: christoph.sonnlechner@wien.gv.at

S. Hohensinner · G. Haidvogl
Institute of Hydrobiology and Aquatic Ecosystem Management (IHG),
University of Natural Resources and Life Sciences Vienna (BOKU), Vienna, Austria
e-mail: severin.hohensinner@boku.ac.at

G. Haidvogl
e-mail: gertrud.haidvogl@boku.ac.at

Introduction[1]

Vienna in the sixteenth century: a sketch

Having been a residence of Babenberg and Habsburg dukes for centuries, two dates in the sixteenth century—1526 and 1529—are most significant for the history of Vienna and the Danube as they affected trade and defense, both functions vital for the city and influenced by the Danube. The two dates are representative of two major developments. In 1526, the Austrian Archduke, Ferdinand, issued a new charter (*Stadtordnung*) for the city of Vienna. As a final written step, this act definitively ended Vienna's autonomy according to which the city had flourished until the first half of the fifteenth century. From 1526 onwards, Habsburg interests as lords of the town clearly dominated the further development of Vienna. Vienna's importance as a hub of trade especially from west to east via the Danube decreased while southern German cities such as the Fugger dominated city of Augsburg prospered economically due to Habsburg protection.

From the second half of the sixteenth century onwards, the city became the permanent residence of the Habsburgs and therewith the Emperors and Kings of the Holy Roman Empire. Vienna became home to institutions like the *Hofkriegsrat* (from 1564 up until 1848), the court council of war of the Habsburg monarchy established in 1556 as *steter Kriegsrat*, and the *Hofkammer*, the court's treasury, to name the most prominent ones.

1529 marks the first siege of Vienna by Ottoman troops. The Turkish threat to what is now Austrian territory had started in the late fifteenth century, and in September 1529 the troops of Sultan Suleiman I stood at the gates of Vienna. Ottoman battleships that had come up the Danube lay anchored at the shores of the river. In 1520, ~30,000 persons lived in Vienna. This number fell to 12,000 in 1530 after the first Ottoman siege. In 1600, the number had grown to ~30–35,000 inhabitants, with 10,000 more living on the outskirts. The Viennese agglomeration as a whole was home to c. 50,000 persons (Weigl 2003, p. 110). A significant share of the city population comprised newcomers connected to the court and its institutions.

The following timeline outlines the pivotal instances and periods of change in sixteenth century Vienna with respect to the Danube (Table 1).

Table 1 Timeline of Vienna's history with the Danube from the fourteenth to the sixteenth century

1376	First mentioning of a water plough in the Viennese Danube for clearing the Danube to facilitate shipping
1439	Emperor and city agree on building and maintaining a stable bridge system crossing the Danube
1526	Archduke Ferdinand issues a new charter (*Stadtordnung*) for the city of Vienna—Vienna looses its autonomy to a large extent
1529	Ottoman troops besiege Vienna for the first time
1556 (1564)	The court's council of war gets institutionalized as *Hofkriegsrat* and starts to be a major actor in matters of the Viennese Danube
1547/57–1659	Court trial referring to land ownership between the major landowners in the Viennese floodplain—the Viennese Burghers' Hospital and the monastery of Klosterneuburg
1548–1572	Years of heavy flooding and massive ice jams and associated fluvial activities
1550s	Peak production of bricks for building the fortress of Vienna; large amounts of fuel wood needed
1565	Commission set in by the Emperor to find a new place for a bridge head (*Tabor*) for the main bridge and define a new route through the floodplain due to massive river changes
1566	Turning point in the hydromorphological history of the Viennese Danube

[1] This text is a product of ENVIEDAN—Environmental History of the Viennese Danube 1500–1890, FWF Austrian Science Fund grant no. P 22265-G18.

Studying Vienna and the Danube

This article concerns how humans dealt with an environment dominated by an ever changing river. Did they try to stabilize this landscape? How did human and natural agency develop in this specific Central European riverine environment and what important periods can we discern in this development? In contrast to for example Richard White's *The Organic machine: the remaking of the Columbia River*, a book that examines "the ways in which humans and nature act together to create new, intermingled forms and processes" (White 1995, p. 22), we wish to pursue an interpretative approach by looking at the co-evolutionary transformation of practices and arrangements on and in the riverscape over almost 500 years. White distinguishes between nature and humans. Rather than investigating the 'natural' and the 'cultural' and their interaction, we suggest investigating 'practices' and 'arrangements', both understood as socio-natural hybrids. All practices are directly aimed at the procurement of resources. Arrangements are equally part of the display of power and thus of the reproduction of social structure. The perceivable, combined change of social as well as of biophysical phenomena, the change of everything that relates to humans in this world, can be described as a transformation of socio-natural sites. Socio-natural sites are nexuses of arrangements and practices. Practices are impossible without material objects and human beings create, via their practices, arrangements from the material world. The arrangements are shaped by practices, being the material precipitates of these (for details of this concept see Winiwarter et al. 2013, in this issue).

The Danube, morphology and climate

When studying the Viennese Danube between 1500 and 1890, one must not forget that there is a larger frame to the small window being researched. The headwaters/upper reaches of the Danube must be considered, as must the centuries preceding the sixteenth century. Though Vienna is situated more than 900 km downstream from the Danube's source, the river still showed a mountainous character with a highly variable flow regime, frequent floods and almost annual ice jams (Liepolt 1965). For the Viennese Danube section, in particular, the regimes of the major alpine tributaries Inn, Traun and Enns are essential.[2]

The local floodplain between the arms consisted of morphologically different dynamic zones, relevant to diverse activities and user groups. On the one hand, there were comparatively stable islands like the central parts of the *Unterer Werd*, an island close to the city, and separated from it by the Viennese arm of the Danube, today called the *Donaukanal*. On the other hand, great parts of the river landscape were characterised by large, more or less dynamic islands (see Figs. 1, 2 in Hohensinner et al. 2013b, in this issue). The development of the highly sinuous main arm in the sixteenth century had already started by the early to mid-fifteenth century.[3] During the first siege by the Ottoman army in 1529, the evolution of the river bend was already at an advanced stage (Fig. 1 in Hohensinner et al. 2013b). First indications of a major rearrangement of the Danube channel network are provided by complaints in the 1550 s about the repeated erosion of the road and gardens between Nußdorf and Klosterneuburg, located upstream (see upper left corner in Fig. 1).[4]

[2] For detailed information on morphology see Hohensinner et al. (2013b), in this issue.

[3] WStLA, HA Urkunden, Nr. 3631.

[4] OeStA, AVA–FHKA, AHK, NOeHA, W 61/c/87/a (875), fol. 2–59; see also for the Hohenauer Steig at the Kahlenberg: OeStA, AVA–FHKA, AHK, NOeHA, W 61/c/b7/b (876), fol. 423–604;OeStA, AVA–FHKA, AHK, NOeHA, W 61/c/7/a (823), fol.

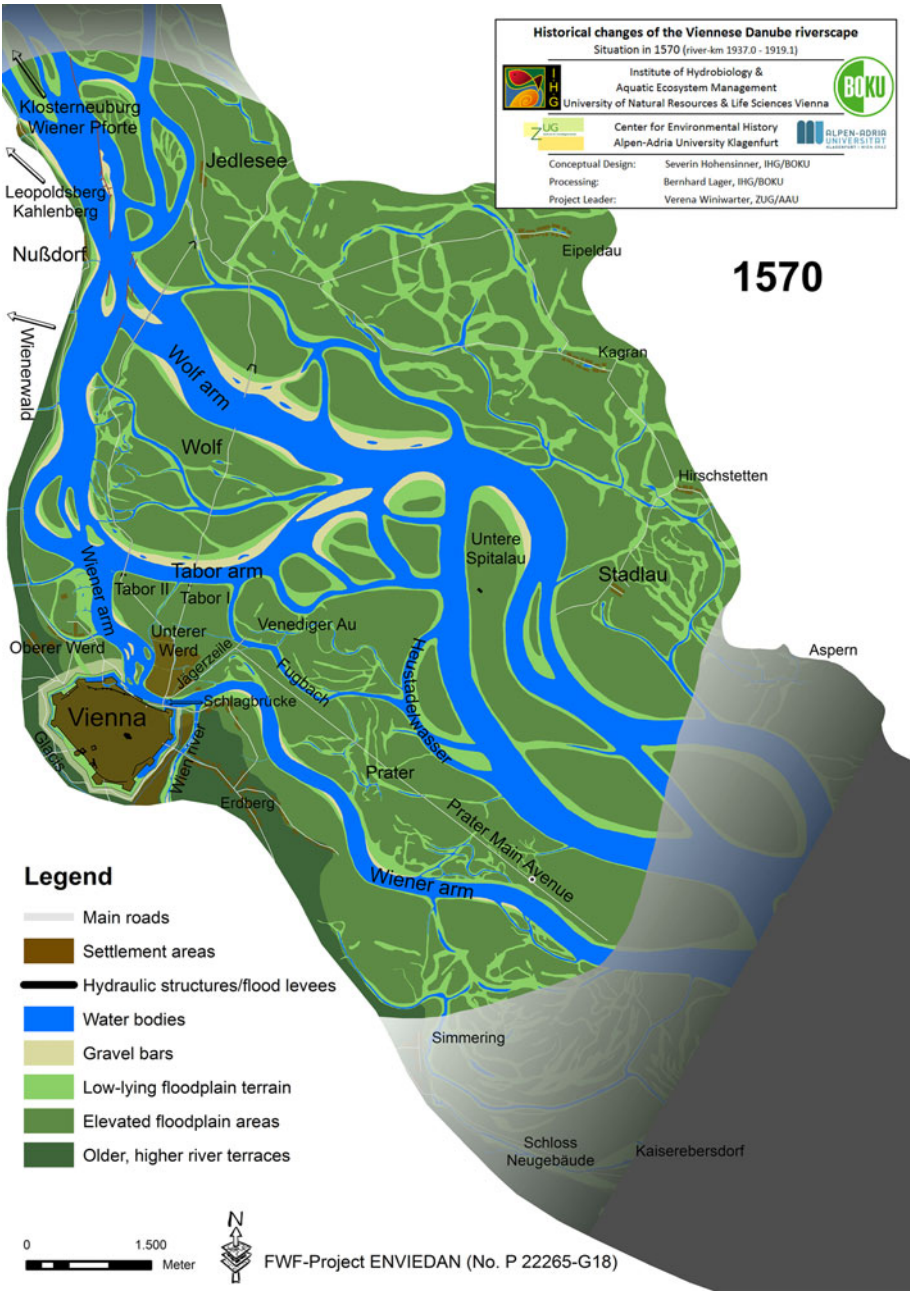

Fig. 1 The Viennese Danube in ~1570. Reconstruction

This shows that the Danube had already started to shift its course within the gorge called *Wiener Pforte*, a short break-through section upstream from Vienna and Nußdorf, towards the south (Fig. 1). As a consequence thereof, the downstream incidence angle of the

Fig. 2 View of the Viennese Danube showing the situation in c. 1570–1580; map drawn in 1632 (the *Wolfsau* refers to the central large island between the bridges). *Stiftsarchiv Klosterneuburg, Sp. 379 (olim 89)*

Danube at the entry from the *Wiener Pforte* to the *Wiener Becken* (Vienna Basin) had also changed, turning from the southeast to the east or northeast, away from the city. This ushered in a new era of—at that time—unpredictable morphological changes, because in the subsequent decades the *Wolfsau* (*Wolf* floodplain) north of Vienna was directly exposed to the main current of the river. Until then, according to historical sources, the *Wolfsau* had constituted a large, comparatively stable island within the Viennese riverscape. In 1558, approximately half of the Danube's discharge no longer flowed through the main river bend called *Tabor arm*, but instead found its way through the northern river arms, primarily through the *Wolf arm*.[5] In the years that followed, the *Wolf arm* widened its profile, the *Wolfsau* was partly eroded and the floodplain further downstream was gradually dissected (compare Figs. 1, 2).

This was the morphological situation when another basic factor behind the development of the Viennese Danube took effect: climate change and associated fluvial activities.[6] As far as we know from the sources and from literature, the timespan between 1547/48 and 1572 in particular brought years of heavy flooding and regular ice jams, both of which caused severe damage. The years from 1565 to 1571 seem to have been the worst in this respect.[7]

Assessing the influence of climate change on the changes and dynamics of the Viennese Danube in the sixteenth century is difficult, but embedding the findings into the larger frame of a central European climate history helps interpret the dramatic changes taking place in the Viennese Danube riverscape during those years. The ice jam flood in 1565 and

[5] OeStA, AVA–FHKA, AHK, NOeHA, W 61/c/7/a (823), fol. 20r,v.

[6] For detailed information on climate see Hohensinner et al. 2013b, in this issue.

[7] See foremost OeStA, AVA–FHKA, AHK, NOeHA, N 27/b/1–3 (460–462); W 61/c/7/a and b (823, 824); W 61/c/87/a and b (875, 876); also WStLA, Bürgerspital, Spitalmeisterrechnungen, Jg. 1548–1572. We thank Andrea Kiss (Szeged) for the hint to look into the Spitalmeisterrechnungen.

several severe winter and summer floods in 1566 can be seen as the turning point in the hydromorphological history of the Viennese Danube. At that time, the river definitively relocated its main current to the northern *Wolf arm*. The former main arm, the highly sinuous *Tabor arm*, degraded to a side arm with less fluvial activity (Fig. 2). At the latest from that point in time, the *Wolf arm* must be seen as the true main channel of the Danube. Going hand in hand with this development, the *Wolf arm* eroded large parts of the *Wolfsau* and after some years once again started to develop a river bend towards the south. Both sudden erosion processes and gradual channel shifting contributed to the overall instability of the Viennese floodplain and caused numerous disputes concerning land properties and problems with transport routes and infrastructure in the riverscape. The underlying reasons, however, can presumably be found in the local morphological configuration of the Danube river system at that time, the regional human-driven changes in the catchment such as land use changes and erosion, and also global climatic changes.

Actors on socio-natural sites

The interests of the actors with respect to the river were as multifaceted as the Viennese Danube itself. First of all, the Danube was a player in that story. Driven by circumstances and processes including weather conditions, climate change or morphological changes, the river changed its course, formed new branches or drifted elsewhere. However, this behaviour was not only driven by nature. The Danube also reacted to human practices such as land clearance in its watershed that caused erosion and boosted bed load transport with consequences including building up gravel banks in sites with less flow velocity or rising water levels during floods. Regulatory arrangements of all kinds also triggered responses by the river. But which actors were the ones intervening into the river regime?

The zones of the Viennese Danube described above and the political history of the time provide clues to this: First, there is the city, then in the process of becoming the permanent residence of the Habsburgs and the Holy Roman Empire, located directly along one arm of the Danube. Being dependent on trade, especially the trade in wine but also several other products like the import of fuelwood or construction timber, Viennese community representatives were interested in maintaining river access to the city. The northeasterly drift of the Danube was a serious problem for the Viennese, and it had to be combatted. This struggle was carried out by the mayor, the council and the treasurer, together with the city's Habsburg lords. Due to their own economic interests, they together with the Viennese funded the measures necessary to regulate the river. The major players communicating the Habsburg interests as visible in the sources were the Lower Austrian government and treasury (*Niederösterreichische Regierung und Kammer*), as well as the court treasury (*Hofkammer*). The Habsburg Emperors and Kings together with this financial institution negotiated with the Viennese and other actors like the monastery of Klosterneuburg. Finally they made water engineering projects possible. The contacts and networks of the Austrian archdukes were also important in organising experts and expertise for the projects. The Viennese were consulted to a degree but in most cases were simply asked for funding.

Another actor with a local but also primarily supra-regional orientation was the military. The continuing Ottoman threat after 1529 ensured that the military played a leading role, which was institutionalised from 1556 in Vienna through the permanent court's council of war, the *Hofkriegsrat*. The military's main interests with respect to the Danube were to maintain the river's proximity to the city since it formed a barrier against all potential enemies coming from the northeast and could also be used as the operational base for the

Austrian navy, which had suffered a disastrous defeat in 1529 and been newly founded thereafter. Thus Vienna became home to an arsenal, at first built on an island of the Danube and later integrated into the fortified town. But the military also acted as a driver with regard to the settlement of the *Unterer Werd*, the relatively stable island to the northeast of Vienna and separated from the city only by the *Viennese arm* of the Danube. Having learned their lesson from the siege of 1529, the military pushed the Emperor to clear all settlements in front of the town walls because these had proven useful for attacking forces, allowing them to use the buildings there to take cover. It was intended that persons having remained in or returning to those settlements would resettle on a then-fortified Danube island, the *Unterer Werd*, allowing a strip of land beyond the city walls, later known as the *Glacis*, to be cleared so that defenders could easily fire on assailants of the fortified city.[8]

Even if it appeared at first glance to be of little worth, the large area of ever-changing islands in the Danube was of interest to diverse persons and institutions. Resources there included fish, wood, meadows, and also birds. The more demand there was for any one of these resources, the more sought-after was the ownership of such islands. In general, large feudal estates owned or possessed rights over the islands in the river, but some belonged to communities neighbouring the Danube. Due to the dynamic character of this landscape, ownership disputes and litigation were common.

Having outlined the key players in this interrelated development of city and river, it still remains to describe how communication on the topic of the Danube took place. Representatives of institutions articulated their common interests through commissions. A commission of this kind referring to Danube activities appears in the sources for the first time in 1548,[9] following flooding that spring. The commission consisted of nautical/shipping experts from Alpine regions of Upper Austria (Enns and Wels), especially the Salzkammergut (shippers [*Schiffleute*] from Gmunden, Ischl, Lauffen, Hallstatt)—a region under the direct political and economic influence of the Habsburg prince—the mayor, advocate, treasurers (*Ober- und Unterstadtkämmerer*) and councillors of Vienna, Viennese shipmasters and fishtraders, fishermen from Vienna and Nußdorf, master-builders and fortification engineers, as well as Habsburg authorities like the *Hansgraf, Vicedom* and *Salzamtmann*, all of which were responsible for trade, funding and taxes. They met in 1548 because an *arch*, i.e. a large fishing trap erected on the bottom of the river (Hoffmann and Sonnlechner 2011; in general Hoffmann 2000), was identified as being the reason for certain problems; the military was not part of this commission, but was represented very often in other commissions during the sixteenth century.[10]

Commissions constituted one approach to the challenges raised by the river. Another concerned the formation of institutions such as the *Brückamt*, which was responsible for maintaining the bridges over the Danube and rebuilding them when broken or washed away. There was also the *Wassergebeuamt* at Nußdorf in charge of all hydraulic works along the Danube, mostly aimed at maintaining the river's direct proximity to the city. These authorities were required to work constantly on the problems they faced because of the river dynamic.

[8] For cases in which the military or war were an actor in a comparable town, see Wroclaw (Hoffmann 1989, Chapter 11, especially p. 236): There, we find a dynamic, island-filled river with a history of occasional droughts. Hence, people feared enemies could attack the city from the unwalled side. Lutheran Wroclaw had a long-standing enmity toward the abbey of St. Vincent, which lay on a big island just across the main channel. In 1529, the fear of Turkish invasion was used by the city authorities to justify the total destruction of the abbey lest it be used as a firing base by Turkish soldiers. We thank Richard Hoffmann for this hint.

[9] OeStA, AVA–FHKA, NOeHA, W 61/c/7/a (823), 17r–23v.

[10] See for example: OeStA, AVA–FHKA, NOeHA, W 61/c/7/a (823), fol. 256–257 (for 1565), 343–345 (for 1571) or OeStA, KA, Hofkriegsrat, 1579 April 1 Exped.

Table 2 Primary actors referring to the Viennese Danube and their position of authority

The Danube itself
The Community of Vienna represented by the mayor, the council and others
Lost authority due to the new *Stadtordnung* of 1526 issued by the lord of town
The Lords of town, i.e. the Habsburgs
Strengthened the position during the sixteenth century; established imperial residence in Vienna
The Lower Austrian Government and Treasury
Lower Austria stood under the direct influence of the Habsburgs who were the *Landesfürsten*
The Court Treasury, an imperial institution
The military, i.e. the court's council of war, an imperial institution
The bridgemaster's office, *Brückmeisteramt*
An institution of both the Austrian prince and the city of Vienna
The water building office, *Wassergebeuamt*
A princely (*landesfürstliche*) Austrian institution
The large seigneuries
In the case of the Viennese floodplain: the prince of Austria, the monastery of Klosterneuburg and the Viennese Burghers' Hospital
Experts and commissions both set in by the Emperor; subject to report

Where severe problems arose, such as changes in the river channel, experts from abroad, so called *Wasserkünstler*—water artists or engineers—were engaged to assist. In the beginning of the sixteenth century, they were called from Alpine regions under Habsburg control. Later on they came from Silesia and especially Italy. Authorities and experts had to work together in commissions and report to the *Hofkammer* or *NÖ Kammer and Regierung*. Frequently members of such commissioners were unable to reach a unanimous opinion, in which case the Emperor himself decided or called for new expert opinion to be sought. Setbacks and long delays were common to all these very costly projects. With respect to the resources used on the islands, conflicts and clashes very often resulted in legal action (Table 2).

River dynamics and their effects on arrangements and practices

Bridges and roads

In 1439, King Albrecht II, lord of Vienna, issued a charter on behalf of the city,[11] allowing the Viennese to erect bridges over the Danube. The Duke of Austria and the city were to pay for the maintenance, with the toll incomes for passing the bridges to be divided between them. Severe weather and other dangers were a threat to all those who wanted to cross the river by ferry, and until 1439 there had only been the so-called *Schlagbrücke*, connecting the town to the *Unterer Werd*, which was sparsely settled and mainly used for pasture, horticultural and agricultural activities. As the city thrived economically and trade increased, a stable bridge became much needed. Till then tradesmen coming to Vienna from the north, for example from Bohemia, had to use a ferry to cross the main arms of the Danube, then take the main road through the *Unterer Werd*, called *Kremser Straße*, until they reached the *Schlagbrücke* leading to the city gate at the red tower (*Roter Turm*). In 1439/40 twelve additional bridges were built, including the two most important, known as

[11] WStLA, Hauptarchiv Urkunden, Privileg 32.

Tabor bridge and *Wolf bridge*.[12] Several small watercourses in between were also bridged, while low-lying terrain had to be traversed with causeways. There was a good reason why all these enormously cost-intensive arrangements had not been erected earlier, since only now did the economic prosperity of the town make such a move possible. An institution, the *Brückamt*, with a bridgemaster in charge was founded to maintain the wooden constructions. Those taking office as bridgemaster together with their deputies were the only administrators sworn in at the city hall,[13] illustrating the importance of the institution (Sonnlechner 2012).

The morphological dynamic of the Danube was the major threat to this series of bridges. We know that in 1530, the bridges were torn away repeatedly,[14] while in 1537, floods twice washed away the bridges, paved roads and causeways. It is clear that the Danube also started to widen its channel profile at that time.[15] But this marked only the beginning of a dramatic process of change that reached its peak in the second half of the 1560s. In 1547, Wolfgang Schmeltzl described his route on approaching Vienna from the north (Schmeltzl 1548). He gave detailed reports of the length of the bridges and included diverse topographical details. Schmeltzl's story makes clear that the *Tabor bridge* was the longest, being nearly double the length of the *Wolf bridge*. And Schmeltzl was fascinated by the amount of timber needed for such constructions. Having crossed the longest of the bridges, the *Tabor bridge*, Schmeltzl reached the *Tabor*, the fortified bridgehead where a toll had to be paid. He then crossed the *Tabor* and finally reached the *Schlagbrücke* and then the city.

Schmeltzl was also informed about the power of ice and water to regularly tear away these massive constructions. And between 1548 and 1565, major flooding took place. The river tended to form new arms towards the north and substantially widened the branch through the *Wolfsau*. The Viennese Danube river morphology changed dramatically. As the *Wolf arm* started to become the main arm of the river, the entire system of bridges had to be rebuilt (Figs. 1, 2 in Hohensinner et al. 2013b, in this issue). In October 1565, the city authorities wrote to the Emperor that a new *Tabor* together with a bridge would have to be erected in a different place. The old one (*Tabor I*) was no longer useable, as the ice jam of the previous winter had washed away all bridges and changed the riverscape drastically (Fig. 1). In response, Emperor Maximilian II formed a commission, led by the Austrian government, consisting of military figures, treasurers, trade authorities, the bridge authority, imperial fortification engineers, water engineers, the advocate and mayor of Vienna, as well as Viennese councilors.[16] This prominent group was instructed to find a new location at which to position a new bridge whilst incurring the lowest possible costs. Due to the heaviest flooding in 1566 and floods in subsequent years, the commission faced serious problems finding a suitable route and location for the new crossing.[17] A new place, the so-called *Neue Tabor* (*Tabor II*), was identified as the best site for building the bridgehead (Fig. 1 and Fig. 2). After bridges were partially erected then washed away only a few months later, engineers from abroad presented models of new bridges constructed partly from masonry.[18] The problems remained (Fig. 3).

[12] WStLA, Oberkammeramt, B 1/1, 1440, fol. 37r, v.

[13] WStLA, Handschriften, A 1/1, fol, 129v for the years 1453 to 1466.

[14] OeStA, AVA–FHKA, AHK, NOeHA, W 61/c/3/a, fol. 60v.

[15] OeStA, AVA–FHKA, AHK, NOeHA, W 61/c/3/a, fol. 229r.

[16] OeStA, AVA–FHKA, AHK, NOeHA, W 61/c/7/a (823), fol. 252–259.

[17] OeStA, AVA–FHKA, AHK, NOeHA, W 61/c/7/a (823), fol. 275–290.

[18] OeStA, AVA–FHKA, AHK, NOeHA, W 61/c/6, May 20, 1569.

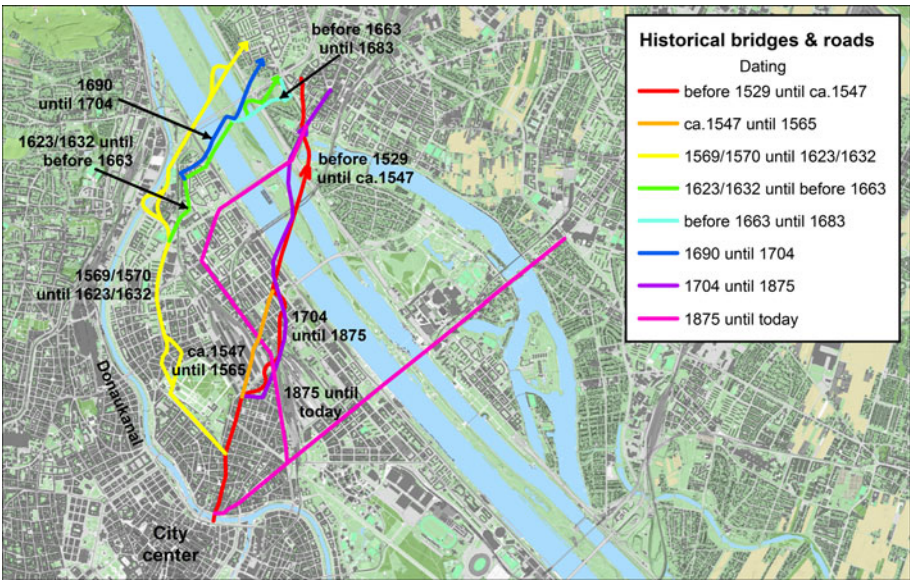

Fig. 3 Identified locations of bridges and road links in the riverscape of Vienna 1529–2010. *Background map: Magistrate of Vienna—MA 41 Stadtvermessung*

The bridge officers at the *Tabor* continually faced new problems, for instance following an ice jam in January 1570 (Smital 1903, p. 44–48; Sonnlechner 2012), when the new fourth, and so-called external bridge that led from the island called *Brigittenau* to the *Wolf* and from there to the northern bank of the Danube, had been destroyed for the umpteenth time and had to be relocated due to profile changes (Fig. 3). Meanwhile, shipmasters had to transport persons and goods across the arm of the river. Moreover, the right to operate this ferry service was itself a matter of dispute. While a subsequent appraisal of the situation by the Lower Austrian Chamber of Councillors (*NÖ Kammerräte*) held first that river transit was a right belonging to the holders of the seigneurie of Jedlesee, the lords of Sinzendorf, while noting on the other hand that they and their subjects had suffered a great deal of damage through the erection of the new *Wolf bridge*, since the bridge ended in their fields. The constant destruction of the bridge and relocation of the bridgehead meant that new roads had to be built, which of course meant a reorganisation of land use and land property. The council proposed to exchange or buy the feudal estate of Jedlesee from its owners. The question of the river crossing was clarified with a resolution (*Abschied*) of the Lower Austrian government in January 1573. On 4 February 1575, the lord of Sinzendorf finally sold the estate with all concomitant rights to Emperor Maximilian II and the mayor and city council of Vienna in the form of the bridge office. The Viennese authorities noted that because of heavy flooding the bridges would have to be relocated, in which case the bridgehead probably would have to be placed on another landowner's land. Being all too familiar with the natural dynamics of the Danube they warned early on that this purchase would most probably be no solution, and events during subsequent centuries proved them right.

Besides those arising at the northern end of the bridge system, problems also appeared at the *Tabor* and the southern part of the *Wolf*. Due to silting up of the *Tabor arm* and the widening of the *Wolf arm*, some landowners gained land on the one hand, on the other more and more land was eroded which caused enormous problems. Bridges had to be

lengthened every year spanning over new water and recently revealed dry land. Holding and securing the bridgeheads was nearly impossible. Embankments and dams were erected and although intended to stabilise the situation, rarely succeeded in doing so.[19]

Another site severely impacted by flooding and river change was the road leading from Klosterneuburg to Vienna, running along the Leopoldsberg (in the sources called *Kallenperg*/ Kahlenberg) on the southern bank close to the river. Here the Danube breaks through a gorge (*Wiener Pforte*) into the Vienna basin. There was little space for a road between the Danube and the hillsides of the Vienna Woods (*Wienerwald*). Nevertheless, this road was an important traffic artery not least because it was used for wine transport. Vineyards were planted on the slopes of the Vienna Woods. In February 1566, flooding was so intensive that the road was washed away. All traffic was diverted through the vineyard of a Viennese burgher who complained about this state of affairs. The Emperor again ordered a commission to consider solutions and it emerged that this was not the first time problems had arisen at this location. From 1558 onwards, Danube flooding, and changes in the river's morphology had eroded land there. Costly hydraulic constructions were ordered but not yet carried out. In the years to come, measures were taken to secure the infrastructure.[20] New arrangements, weirs, fascines and embankments were supposed to solve the 'natural' hazards.

Keeping the river in town: river engineering

The increasing challenge facing the city of Vienna was the shifting away of the river from the city throughout the sixteenth century. This development brought severe problems with it: After flooding, gravel banks appeared that hampered shipping at times of low water. Ships had to be unloaded at other locations and transporting goods to the city was time consuming and costly. The practice of clearing the gravel from the branch of the river leading to the city was very expensive. The Viennese burghers and the military were the two key actors interested in maintaining the navigability of the Danube (Camesina 1881, p. 90). Since the river formed a barrier that kept enemies from the city, the members of the *Hofkriegsrat* wrote expert recommendations that a major river branch should be kept close to the city.[21]

As shown above, sources on interventions into the river already exist for the fourteenth and fifteenth centuries. In the reports from the Middle Ages it was clear that the process of river bed aggradation caused problems (Chmel 1855, p. 373). We read about a *wazzerphlug*, a plough used for loosening bed material in order to facilitate sediment dredging, a method also used at that time in alpine Danube tributaries (Eder 1998). This tool was still in use in the sixteenth century, but water engineers like the Tyrol-born Hanns Gasteiger experimented with new technology.[22] Gasteiger had gained outstanding skills in this field in the mountainous Salzkammergut but in 1555 the Emperor assigned him to works in Vienna, where he was active for nearly twenty years. His activities comprised clearing the Danube from wood after flooding, keeping water in the moat, establishing a

[19] OeStA, AVA–FHKA, AHK, NOeHA, N 27/b/1 (460), fol. 266r, 290r for the year 1571.

[20] OeStA, AVA–FHKA, AHK, NOeHA, W 61/c/87/a (875), fol. 2–59; for the Hohenauer Steig at the Kahlenberg recte Leopoldsberg see: OeStA, AVA–FHKA, AHK, NOeHA, W 61/c/b7/b (876), fol. 423–604; OeStA, AVA–FHKA, AHK, NOeHA, W 61/c/7/a (823), fol. 314 for 1569; OeStA, AVA–FHKA, AHK, NOeHA, N 27/b/1 (460), fol. 290v for 1571.

[21] OeStA, KA, HKR, 1579 April 1 Expedit.

[22] OeStA, AVA–FHKA, AHK, NOeHA, N 27/b/1 (460), fol. 223–226 for 1563 and 264–265 for 1571, see also OeStA, AVA–FHKA, AHK, NOeHA, W 61/c/7/a (823), fol. 294–309 for 1567.

water conduit for the castle of *Neugebäude* close to Vienna, building bridges and providing expertise regarding water engineering issues. His major efforts were dedicated to maintaining the river's proximity to the city (Thiel 1903, p. 131–136). He served in several commissions, often expressing opinions opposed to the other commission members, but was held in high regard by the Emperor. He constructed new machines, including an excavator for clearing gravel banks from the river, erected weirs and managed extensive projects in water engineering.

Key locations for river engineering interventions were at Nußdorf, at the *Wolf* and *Tabor*, as well as on other islands in the river, and last but not least directly in front of the city walls, not to mention the bridges referred to above. For many decades, work had to be undertaken at Nußdorf, where today the inflow of the *Donaukanal* is located. The Danube started to break through to the northeast, bisecting through *Wolf* island (see Fig. 1) and shifting away from the city. For more than half a century, beginning in the second half of the sixteenth century, water engineers attempted to redirect the main branch of the river by constructing systems of weirs, dams, embankments, ditches and many other measures (Fig. 4; see also Fig. 3 in Hohensinner et al. 2013a, in this issue).

Arrangements like weirs were built from massive oak trees, sometimes constructed on a stone foundation, and coppice wood for fascines. Construction lasted for weeks and months, required a lot of material and manpower and was extremely cost intensive. Despite this, ice jams and flooding destroyed these structures regularly, transforming the whole arrangement. New assessments—commonly involving both a commission and individual experts—were required before further action could be taken to regulate the Danube. A plan to excavate a wide channel on the right side of the river directly at Nußdorf was discussed for many years before being implemented sometime between 1571 and 1579 (see "G" in Fig. 4).[23] This channel and others mentioned in the sources were supposed to direct the flow of water from the northern to the southern river bank in order to prevent an uncontrolled breakthrough of the Danube and to amplify the inflow into the Viennese arm. The same discussions took place regarding ship-mills placed on the northern side of the river. Expert advice suggested moving them to the southern side so that the mills would attract the water and help direct it into the Viennese arm,[24] and a royal patent was issued as early as 1572 demanding that millers should remove all ship-mills from their current locations.[25]

While all these arrangements addressed the drift of the river away from the city to the northeast, other measures had to be taken at the *Tabor*. After the bridgehead was relocated to the so-called "*Neue Tabor*" after 1565 and a new route across the island determined, a new problem appeared: in the year of the heaviest floods and ice jams, 1566, a new channel had appeared that diverted the flow against the new *Tabor*, causing erosion at the site of the new *Tabor* while forming a gravel bar at the same time (see *Tabor II* in Fig. 1). The island had to be secured and the flow redirected towards the city centre via the Viennese arm.[26]

[23] Terminus post quem: OeStA, AVA–FHKA, AHK, NOeHA, N 27/b/1 (460), fol. 290r for 1571, terminus ante quem: OeStA, KA, HKR, 1579 April 1, Expedit, map. See Fig. 4. Further: OeStA, AVA–FHKA, AHK, NOeHA, N 27/b/1 (460), fol., 112–113; OeStA, AVA–FHKA, AHK, NOeHA, W 61/c/7/a (823), fol. 278–280 and 303–304 for 1567.

[24] OeStA, AVA–FHKA, AHK, NOeHA, N 27/b/1 (460), fol. 1188–1190, expert opinion by Maximilian Saurer app. 1600, see nr. 3.

[25] WStLA, Patente, nr. 161 from 1591 recalling a patent from 1572.

[26] OeStA, AVA–FHKA, AHK, NOeHA, W 61/c/7/a (823), fol. 278–280, 294–297, 303–304, 309r, 312, 322, 337, 339, 344v: for the years 1567–1571.

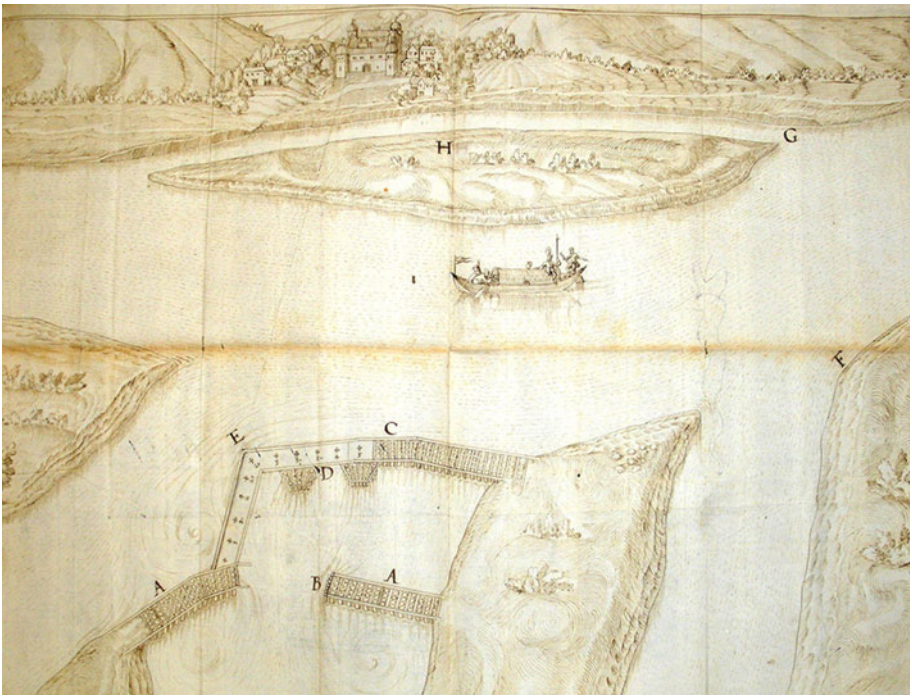

Fig. 4 View of Nußdorf from c. 1570 s, showing the main arm of the Danube and river engineering measures in the foreground. *Österreichisches Staatsarchiv, Kriegsarchiv, Hofkriegsrat, April 1 1579 Exped. Kartenbeilage, Nußdorf*

Therefore, in 1568 Gasteiger proposed an enormous project encompassing clearing the river bed at the *Tabor* and bringing 1,000 barge-loads of stones to secure the endangered places. He probably also intended to partially block the *Tabor arm* directly north of the new *Tabor* (*Tabor II*) in order to direct the flow into the Viennese branch (*Wiener arm*) towards the city (Fig. 1). Although it seems that this project was not carried out in its entirety, before even starting final negotiations with Gasteiger on his remuneration and project costs, Emperor Maximilian II gave the order to quarry stones and ship them to the indicated places.[27] If these plans were at least partly carried out, this would have boosted terrestrialisation of the former main Danube arm, the *Tabor arm* and would have formed the starting point for the development of the island that is jointly the location of today's Viennese districts of Leopoldstadt and Brigittenau.

We also know that water engineering works such as fascines were erected to protect a highway and smaller islands like the *Fux* islands between Klosterneuburg and Nußdorf, upstream of Nußdorf/Vienna.[28] Islands were valuable, as sources of both fuelwood and construction timber, and feudal landowners holding such islands attempted to secure them as the Danube broke through. The extremely useful source of the *Spitalmeisterrechnungen*, account registers of the Viennese Burghers' Hospital, provide yearly information about the establishment of weirs (*wühr*) to protect the islands owned by the hospital. For the period

[27] OeStA, AVA–FHKA, AHK, NOeHA, W 61/c/7/a (823), fol. 322v and 324–327 (Gasteigers's proposal).

[28] OeStA, AVA–FHKA, AHK, NOeHA, W 61/c/87/a (875), fol. 172–173 and 192–373 for 1567/68; OeStA, AVA–FHKA, AHK, NOeHA, W 61/c/b7/b (876), fol. 486–487 and 565–572 for 1569.

from 1548 to 1572, there is evidence that in seven years (1553, 1557, 1558, 1559, 1563, 1565 and 1566) the erection of such edifices was necessary.[29]

Vienna as a fortress, building at and in the water: (re)settling and fortifying the "insula"

In 1529, Vienna was ill-prepared to defend itself from a siege. The medieval wall encircling the city was not appropriate for early modern warfare and Vienna only narrowly avoided being defeated by the Ottoman troops. As a consequence, the Emperor and the city authorities agreed that the city should be fortified in the style of the contemporary Italian model, for which Italian fortification engineers were engaged. Due to a persistent lack of funding, the entire project stretched over decades (Eberle 1911, p. 218–282).

The Austrian navy with its arsenal at the *Unterer Werd* close to the mouth of the tributary called *Wien river* (*Wienfluss)* had been utterly defeated and destroyed by the Turks (for *Wien river* see Fig. 1). After the siege, a small island in the *Wiener arm*, located only a few metres in front of the city wall, was adopted as a temporary arsenal and fortified with fascines erected all around. In 1546, Emperor Ferdinand I decided to integrate the arsenal within the fortified city. This decision created new problems that soon occupied the fortification engineers. The *Wiener arm* of the Danube came very close to the city walls and sometimes washed away the small strip of shore in front of the wall, only to build up a bank of gravel and earth again a decade later. In decades of severe flooding, this site was subject to rapid changes. Maps of the time do exist, among them the two related ones by Hirschvogl[30] and Wolmuet[31] of 1547, or the map produced by Angielini[32] from the second half of the sixteenth century (Fig. 5). All three were drawn in a military context. Whether the situation depicted along the Viennese arm reflects a historic reality cannot be ascertained. The Wolmuet map shows planning for the city project to improve fortification. Angielini's draft of the Danube front is more realistic in this respect, but nevertheless just the depiction of a moment. In a written source from January 1537 we read about a flood that washed away the shore in front of the wall between the city gates of *Salztor* and *Rotenturmtor*. The source indicates that this strip of land was used for riding and transport.[33] Wolmuet and Hirschvogl once again depict a shore at this location in 1547.

Although the imperial decision to build a new arsenal was made in 1546, this time within the town walls with access to the Viennese arm of the Danube, construction did not begin until 1558, finishing in 1561. However, just as the process of fortification neared an end, massive problems with undermining emerged. In accounts from 1561 and 1563 we

[29] WStLA, Bürgerspital, Spitalmeisterrechnungen, 1553, fol. 53r,v; 1557, fol. 60v–62v; 1558, fol. 73r–75r, 1559, fol. 66v–68r; 1563, fol. 74v; 1565, fol. 77v–79r and 1566, fol, 73r–74v.

[30] WStLA, Kartographische Sammlung: Allgemeine Reihe, Pläne und Karten: Sammelbestand, 1.

[31] M. Bonifatius Wolmuet, Vienna, 1547, Wien Museum, Topographische Sammlung, Sign. 31.021: Die fürstliche Stat wien in Osterreich wie Sy in Irem umbschwaif oder zarg beflossn. aus recht Geometruscher waß im grundt nidergelgt und ….

[32] Nicolaus/Nicolo Angielini (also Angielus; also Natale or Paolo Angielini), Vienna, approx. 1566 (ev. 1574), three versions of the depiction are delivered: nr 1 Österreichische Nationalbibliothek, Handschrift-, Autographen- u. Nachlass-Sammlung, Codex 8609: Mappae geographicae regni Hungariae et terrarum adjacentium a… : fol. 7; nr 2 Sächsisches Hauptstaatsarchiv Dresden, Rißschr. XXVI, 96, Nr. 11, OHMA; nr 3 Generallandesarchiv Karlsruhe, Hfk Planbände XV, Grenzstätten gegen die Türkei vom Meer bis Siebenbürgen, Nr. 6.

[33] OeStA, AVA–FHKA, AHK, NOeHA, W 61/c/3/a, fol. 229r.

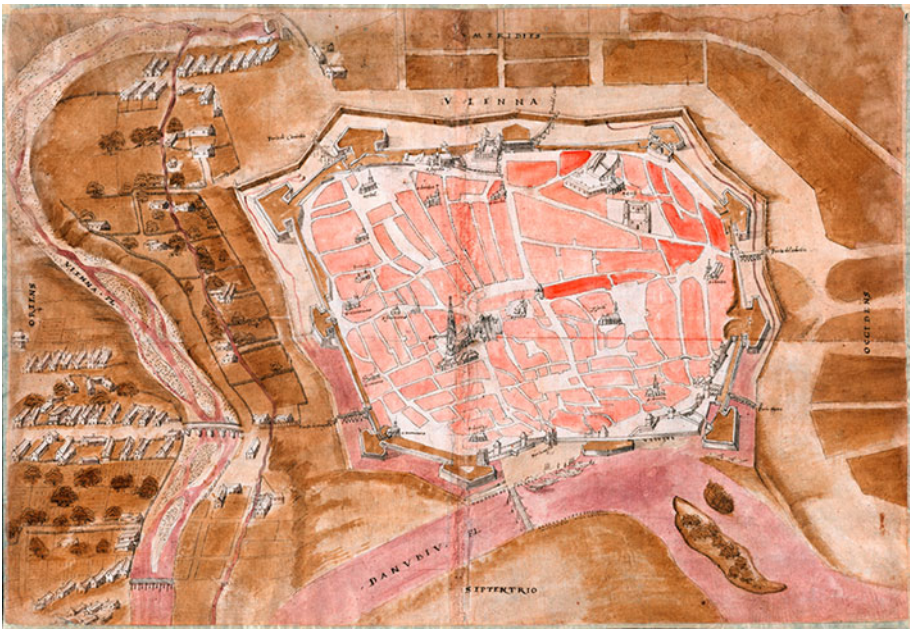

Fig. 5 View of the fortified town with the *Wien river* (*Wienfluss*) at the left margin and the Viennese branch of the Danube (*Wiener arm*) in the foreground seen from the north. *Generallandesarchiv Karlsruhe, Hfk Planbände XV, Grenzstätten gegen die Türkei vom Meer bis Siebenbürgen, Nr. 6: Wien (1566–1574)*

read that the walls, especially those adjoining the Danube, where the newly built *piata forma* (a fortified platform between two bastions, and the arsenal were located) required protection from being undermined/scoured by the river (Camesina 1881, XXII and XXX). Earth had been torn away at the gate to the arsenal. The construction of a dam consisting of stones and earth secured by tree trunks was recommended. The Viennese magistrate was charged by the *Hofkriegsrat* with building a weir (*Wehr*), but refused to do so, a proposal that was still being discussed in 1577 (see also Eberle 1911, p. 251-254).

It was also in 1577 that the military returned to an important strategic plan from ten years earlier: the settlement of "the island" (*die Insel*) called the *Unterer Werd*. In response to the experience of 1529, when the enemy was able to take cover in the houses of the suburban settlement, military authorities wanted to clear this area in front of the walls and resettle the population on the island. Once again, however, money and the Emperor's concerns hampered the endeavour. The advantages listed by the military were manifold, and included the fact that the enemy would not be able to move close enough to the city to bombard it. With the island requiring fortification, measures to raise the terrain for settlement were discussed (Eberle 1911, p. 267–269). Although the leading fortification experts engaged by the Emperor, Pietro Ferabosco and Antonio Baldigara (also Waldegara or Baldissara), began the undertaking and surveyed the island, also producing a sketch to which we have access,[34] no further action was taken because the Ottoman threat decreased. The island was thereafter settled gradually and in an unplanned way. In 1596, when a Turkish invasion of Austrian territory again seemed likely, the military presented the plan again and a commission was assembled. The commission concluded that it would be

[34] OeStA, KA, HKR, 1579 April 1 Expedit.

difficult to retain the Danube's proximity to the city. Experts worked on the problem for a further three years but with questionable success (Eberle 1911, p. 225–227) and again no action was taken.

The military constituted only one aspect in the whole process of settling the floodplain and especially the *Unterer Werd*. Populating the island had begun in the late thirteenth century and then increased in the second half of the fourteenth century. The settlement's nucleus was the so-called *Neidecker Hof*, an agricultural production unit that appears in the sources in 1300. In the second half of the fourteenth century, a *Neidecker* lane and a *Kremser* street were identified, the former named after *Neidecker Hof* and the latter indicating that the way to the town of Krems traversed the *Werd*, a route used by traders who then took the ferry across the river (Müller 1900, p. 172–184). Urban development of *Unterer Werd* in the sixteenth century was still affected by the fluvial dynamic of the Danube, in particular along the bank of the *Wiener arm* (Haidvogl et al. 2013, in this issue). Thus spatial expansion was oriented toward the northeast and east, where stable terrestrial zones existed. At the turn of the sixteenth century, almost 100 buildings existed on the island and through the sixteenth century, and an accumulation of new buildings can be observed in the 1550s and 1560s, when the city fortification improvements meant that many had to leave the city. The mayor and the city council offered them new plots of land and houses in the newly urbanised area in the north of the island. In 1569, Emperor Maximilian II offered land parcels to his court hunters (*Hofjäger*) in an area called *Venediger Au*. This area became an independent Viennese suburb known as *Jägerzeile*.

Resource use in the Viennese waterscape

Resource use in the Viennese waterscape was manifold: practices like fishing, haymaking, hunting birds and primarily harvesting fuelwood and smaller amounts of construction timber were carried out. In the following section, we focus on practices and arrangements of woodland use.

As shown above, we find evidence of stable islands in the river like the *Unterer Werd*, but the riverine landscape containing the majority of islands was highly dynamic; islands grew and eroded again, or even disappeared, while others appeared after a flood. On this unstable terrain, timber with short rotation times, coppice wood, was harvested, including willow, alder and hazel. It was used mainly as fuelwood and for several applications in building construction, such as fences or facades. Examining the timber use for water edifices, we find two kinds of timber needed for such arrangements: wooden piles for securing buildings from undermining and large weir constructions and embankment protection (Camesina 1881, p. 83). Thousands of tree trunks were felled to construct hydraulic works.[35]

Besides the large quantity of timber needed for construction, enormous amounts of fuelwood were needed for brick production to be used in building the new fortification of Vienna.[36] The new fortress was planned throughout the 1530s and particularly the 1540s. In the late 1540s, Italian fortification engineers were hired and through the next two decades millions of bricks for the construction were produced, requiring the input of a vast amount of energy. The first four brick-kilns were erected in the moat in 1548, and two

[35] OeStA, AVA–FHKA, AHK, NOeHA, W 61/c/87/b, fol. 482–681.

[36] For comparative energy needs of London and Paris see Galloway et al. (1996), p. 455–458; Le Maresquier-Kesteloot (1995); summarising Hoffmann (2007), p. 305–308.

more in 1549 (Camesina 1881, XIII, p. 65 and XV, p. 67). In the mid-1550s, fortification activities reached their peak, as did the demand for fuelwood. Precisely at this time, an intense dispute arose between the two financiers of the fortification—the Viennese authorities and the Emperor. The Emperor blamed the Viennese for charging too much for brick production. In a contemporary report, the Viennese justified the sum of 2 pounds, 2 shilling and 9 pennies for 1,000 bricks instead of the stipulated 2 pounds as follows: The production costs were continuously rising because fuelwood was not available. A few years earlier, the wood had only required transportation to the brick-kilns from about three to four miles away, but by this time, the distance amounted to eight or even nine miles upstream, making production more expensive. Producing the bricks in places other than Vienna would of course have been cheaper, but transporting the heavy bricks was very costly. Transporting fuelwood was still more economic. Another reason for the increased price concerned the fact that large amounts were stolen during storage. Moreover, they argued that the model used for baking the bricks was now, following on from the desire of the fortification engineers, larger than the previous one. Lastly they stated that in 1555 they turned the production over to private producers which led to ballooning costs. They had also completely reorganised the process in 1556 in a bid to avoid a complete standstill of the whole construction works. Instead of two, they were now operating eight brick-kilns the expense being paid for from their own funds. They stated that the demand to pay 2 pounds per 1,000 bricks would eventually ruin the community and was therefore unacceptable. They attached an accurate compilation of costs and threatened to halt production, which would have brought the fortification project to a complete standstill.[37]

From 1557 to 1559, several references to cutting timber in the floodplains and indications of local fuelwood scarcity can be found.[38] A complaint from 1557 by the person in charge of the fortification works, Hermes Schalauzer, makes the problem clear. Schalauzer had petitioned the Emperor saying that the former Imperial court huntmaster (*Jägermeister*) had refused to let the woodcutters into the floodplains of Kaiserebersdorf in the beginning of 1557 due to the ice jams. Schalauzer was charged by the Emperor to send the cutters to *Ebersdorf* to cut fuelwood for the production of bricks for fortification and the imperial hunting castle of Kaiserebersdorf, today located at the Danube's right bank in the eleventh district to the southeast of Vienna. Once the ice jams were over and having lost two months' production, he wanted to send the wood cutters to work again and ordered them to cut even more in the floodplains of the villages around Vienna to compensate for the time lost. The Emperor himself had ordered that the surplus of wood from these villages should be used but the order had not been adhered to. Indeed on the contrary, the new *Jägermeister* informed Schalauzer that he had already sent a great amount of timber from these places to Vienna. Since the bad weather and the ice jams had destroyed a lot of land, he argued that the inhabitants had not yet had the opportunity to gather their own fuelwood as was their traditional right. However, should there be a surplus in spite of this situation, Schalauzer would receive it.[39] This example affords us a glimpse of the social differentiation of resource user groups and their possible access to such resources.

[37] OeStA, KA, HKR, 1557 März 153 Expedit.; parallel: OeStA, AVA – FHKA, AHK, NOeHA, W 61 A-2/1, fol. 111–126r.

[38] OeStA, KA, HKR, 1557 Februar 119 Expedit, fol. 311.; OeStA, AVA–FHKA, AHK, NOeK, ER 1559-1 (43), fol. 7v, 42r, 48rv, 51v, 77r, 92r and 105v—all for 1559. We thank Markus Jeitler and Heike Krause, both Vienna, for this citation.

[39] OeStA, AVA–FHKA, AHK, NOeHA, W 61/c/3/b, fol. 514–517.

Still more significant regarding resource conflicts is a dispute between the monastery of Klosterneuburg, a few kilometres upstream of Vienna and the Viennese Burghers' Hospital (*Bürgerspital*) over islands in the Danube. These two seigneuries were the largest landowners besides the Austrian dukes on the floodplain. Litigation between the parties began in 1547 and lasted for 112 years. The dispute began already in 1545, when the Viennese authorities complained to the Lower Austrian government that an official of the monastery had ordered woodcutting on a floodplain claimed by the Burghers' Hospital,[40] in response to which the government ordered a site inspection at the long *Tabor bridge*. Klosterneuburg's provost refused to attend, however, and in July 1547, the provost himself sued the hospital for cutting and removing wood on Ash Wednesday of the same year from a floodplain forest claimed by the monastery. The first lawsuit in front of the lower Austrian government began and two more followed in 1557, the year in which diverse conflicts arose concerning rights to the wood that had become extremely valuable due to the building of the city fortifications. On 8 April, the provost sued the hospital and on 9 April, the Viennese sued the monastery for cutting timber on their floodplain territory. The course of events may have been the following: an island claimed by the monastery had eroded over time or, rather more probable, rapidly after heavy flooding. A new island had appeared, which was located close to the islands used by the Burghers' Hospital. Once wood had grown on the islands to the point where it could possibly be cut for the use as fuelwood, the disputes began (compare for the Rhône in eighteenth century Lyon: Reynard 2010). After each party had sued the other, the court began to ask witnesses what the name of the contested island was, who had used its resources in the past and to whom it belonged. The picture that emerged after the interviews was confusing rather than clear and the lawsuit continued over decades, while commissions were appointed, on-site inspections failed, and spectacular incidents happened such as the one in May 1580, when after an ice jam the Viennese authorities wanted to erect a weir to protect the island from being torn apart but were stopped by the Klosterneuburg provost, who had appeared in person, armed with a rifle, cursing the workers from the hospital (Fig. 6a, b).

Meanwhile, the Danube had changed its course several times, islands grew and diminished, appeared and disappeared. The entire dispute became more and more litigious as the two parties searched through all material they could find in their own archives to prove that they had used and owned the contested island, as though the Viennese floodplain as a whole were stable and one could locate islands over a period going back to the twelfth century. The monastery even presented a charter from the early thirteenth century that threatened anyone trying to expropriate an island belonging to the monastery with excommunication. Depictions, some of artistic value, were drawn up supposedly to clarify the nature of the dispute (see Figs. 2, 6a, b).[41]

Eventually in 1611, judgements were pronounced in all three lawsuits. The Lower Austrian government as the court of first instance ruled in favour of the Burghers' Hospital. The monastery of Klosterneuburg did not accept this sentence, even after a commission in 1618 had already handed over the island to the hospital. In 1620, Klosterneuburg appealed to the *Reichshofrat,*[42] the highest court of the Empire. This appeal was accepted by the court in 1621 yet although the court decided in favour of the monastery, the transfer of ownership failed yet again because the opposing parties could not agree as to which island

[40] WStLA, Bürgerspital, Akten XII/1 and LV/1.

[41] WStLA, Bürgerspital, Akten XII/1; Wien Museum, Inv. Nr. 95961/1-4; Stiftsarchiv Klosterneuburg Sp. 379 (olim 89).

[42] OeStA, HHStA, Alte Parger Akten 125 (alt 106, 107, N2), fol. 338r–393r.

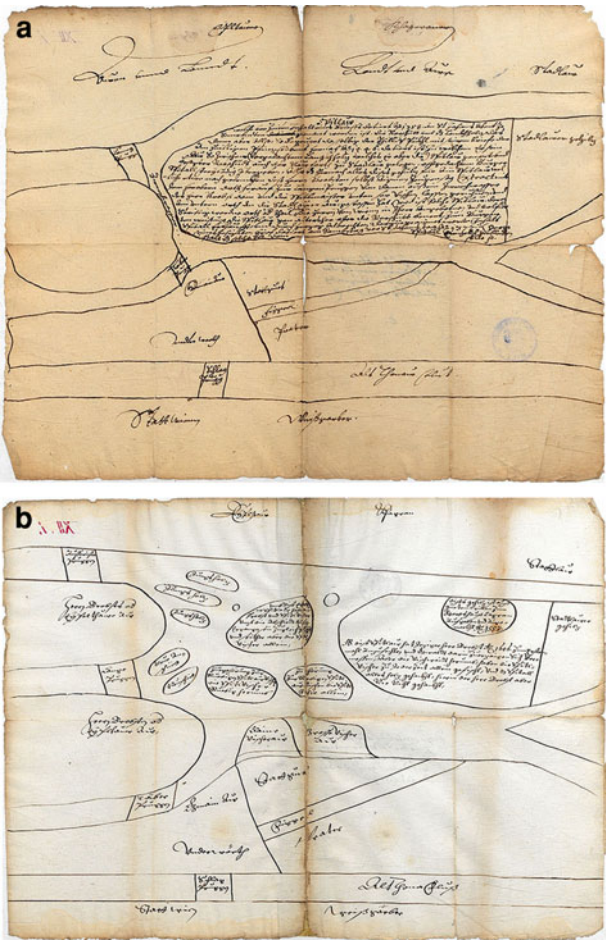

Fig. 6 **a, b** Sketches of the Viennese Danube before and after major changes to the river's course during the second half of the sixteenth century, showing the riverscape in flux. *Wiener Stadt- und Landesarchiv, Bürgerspital, Akten, XII/1: 2 Kartenbeilagen*

the sentence referred to. Years of costly quarrels ensued, with the provost from 1606 onwards also claiming the large island called *Untere Spitalau* which had not previously been the subject of the dispute and caused great problems for the hospital.

After 85 years of litigation, no-one really had an idea anymore what the conflict was about. Every aspect of the case proved highly problematic because the river system was anything but stable, and since the opposing parties used different names for the islands in dispute, the confusion was complete. Meanwhile several commissions had failed to resolve the issues and the court had no idea how to proceed. In 1632 a *votum ad imperatorum*, an imperial sentence only rendered in very complicated cases and by the Emperor in person, was delivered, which again ruled in favour of the monastery. The hospital did not want to accept it and in 1636, an on-site inspection took place, again without any result. In 1655, the Lower Austrian government decided just as the imperial court had done before. The Viennese were still not willing to accept it and considered appealing to the imperial court

again. They prepared a paper of more than 100 pages arguing their point of view but finally, in 1659, both parties agreed on a compromise, which more or less affirmed what the courts had already decided.[43]

What had started as a struggle over very valuable resources ended 112 years later, having consumed thousands of pounds in court fees and legal expenses. Only the regulation of the Danube in the 1870s eventually brought an end to legal disputes of land ownership that had continued after 1659. A winner could not be identified in such cases as the picture changed fast. Sometimes one party gained territory only to lose it on other occasions—due not to court decisions but to the dynamic of the river. The actors concerning this socio-natural site were institutions that clearly lacked the means to cope with the dynamic of the river and were unable over centuries to depict the problematic, having failed to grasp the impossibility of solving the problems by legal means. A comparison with other actors involved with the Upper Austrian Danube shows a heterogeneous picture. Strategies of handling river dynamics were different and seem to have been effective in certain settings at certain times (Winiwarter and Schmid 2010). The question arises to what extent agrarian societies were able to cope with changing fluvial dynamics and whether the nature of the actors involved, i.e. being institutions, communities, individuals, etc. resulted in different successful adaption strategies.

Synthesis

The Viennese Danube floodplain in the sixteenth century was a socio-natural site composed of sub-sites, as we have seen. Hotspots of activity were close to town, at Nußdorf and on the ephemeral islands of the floodplain. These hotspots played a major role for various human practices, most of all transport and trade. In order to improve and maintain the practices, certain arrangements had to be made that changed the socio-natural site: Bridges were erected and then needed to be maintained. The same applies to bridgeheads, paths, causeways, streets and toll stations. In the case of the island of *Unterer Werd*, this meant increasing settlement and a growing strategic importance. Due to military considerations and practices, settlement and fortification changed at least the perception of the floodplain. The city boundary neighbouring the Danube was fortified, stone edifices and an arsenal were erected directly at the water's edge with accompanying problems of the river undermining the built structures.

The most severe interventions were those that took place at Nußdorf, where the redirection of the river as a whole was attempted. Extremely costly water engineering practices were carried out by professionals, not only at Nußdorf to keep the river in close proximity to the city, but also at the bridgeheads and for flood protection directly at the islands. Weirs, dams and embankments were established.

Eventually, resources on the floodplain became valuable as a result of the fortification works and the need for fuelwood. An intensive timber trade, especially driven by coppice wood production, was established there. The dynamics of the floodplain shifted the production area and caused legal problems that intensified as the resource for which access was disputed increased in value. All measures undertaken were aimed at stabilising the floodplain, so that it could be used for settlement, transport and resource use—especially timber production—and so that the boundaries of the areas in use could be clearly defined. This desire for stabilisation can be seen from the sources clearly from the sixteenth century

[43] WStLA, Handschriften, A 1/1, fol. 277r.

onwards. It has to be seen as an aspect towards territorialisation. In large parts of the riverscape, however, such measures were doomed to failure until the 1870s: Danube floods and ice jams repeatedly wiped out human constructions and infrastructure, giving rise to plans for new arrangements. Human expectations of stability in a riverine landscape simply failed to grasp the fact that the natural world was always changing.

Acknowledgments For assistance and courtesy we are indebted to the archivists of the Austrian State Archives (Österreichisches Staatsarchiv, OeStA) in Vienna: Michael Hochedlinger (Kriegsarchiv, KA), Herbert Hutterer (Allgemeines Verwaltungsarchiv—Finanz-und Hofkammerarchiv, AVA—FHKA) and Thomas Just (Haus-, Hof-und Staatsarchiv, HHStA) as well as to Heike Krause (Stadtarchäologie Wien). We thank especially Richard C. Hoffmann (University of Toronto) and Didier Pont (IRSTEA, France) for their very valuable comments and encouragement.

References

Camesina A (1881) Urkundliche Beiträge zur Geschichte Wien's im XVI Jahrhundert. Hölder, Wien

Chmel J (1855) Zur Geschichte der Stadt Wien (Wiener Stadtrechnungen u.s.w. 1368–1403). Notizenblatt: Beil Arch Kunde österr Geschichtsquellen 5:325–400

Eberle L (1911) Wien als Festung. Geschichte der Stadt Wien 4:218–282

Eder B (1998) Historische Entwicklung der Salzach einschließlich der baulichen Maßnahmen: Erstellung eines visionären Leitbildes. Master thesis, University of Natural Resources and Life Sciences Vienna

Galloway J, Keene D, Murphy M (1996) Fuelling the city: production and distribution of firewood and fuel in London's region 1290–1400. Econ Hist Rev 49:447–472

Haidvogl G, Horvath M, Gierlinger S, Hohensinner S, Sonnlechner C (2013) Urban land for a growing city at the banks of a moving river: Vienna's spread into the Danube island Unterer Werd from the late 17th to the beginning of the 20th century. Water Hist. doi:10.1007/s12685-013-0078-y

Hoffmann R (1989) Land, liberties, and lordships in a late medieval countryside: agrarian structures and change in the Duchy of Wroclaw. University of Pennsylvania Press, Philadelphia

Hoffmann R (2000) Medieval fishing. In: Squatriti P (ed) Working with water in medieval Europe: technology and resource-use (Technology and change in history vol. 3) Brill, Leiden-Boston-Köln, pp 331–393

Hoffmann R (2007) Footprint metaphor and metabolic realities. In: Squatriti P (ed) Natures past: the environment and human history. University of Michigan Press, Ann Arbor, pp 290–325

Hoffmann R, Sonnlechner C (2011) Maximilians Patent über das Fischereiwesen von 1506. In: Studien zur Wiener Geschichte: Jahrb Ver Gesch Stadt Wien, Bd. 62 (2006/2007), pp 71–124

Hohensinner S, Sonnlechner C, Schmid M, Winiwarter V (2013a): Two steps back, one step forward: reconstructing the dynamic Danube riverscape under human influence in Vienna. Water Hist. doi:10.1007/s12685-013-0076-0

Hohensinner S, Lager B, Sonnlechner C, Haidvogl G, Gierlinger S, Schmid M, Krausmann F, Winiwarter V (2013b): Changes in water and land: the reconstructed Viennese riverscape from 1500 to the present. Water Hist. doi:10.1007/s12685-013-0074-2

Le Maresquier-Kesteloot Y-H (1995) L'approvisionnement de Paris en bois (XIVe–XVe siècles). Franco-British Studies 20:69–83

Liepolt R (1965) Limnologie der Donau. E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart, Germany

Müller R (1900) Wiens räumliche Entwicklung und topographische Benennungen vom Ende des XIII. bis zu Beginn des XVI. Jahrhunderts. In: Geschichte der Stadt Wien, vol. II/1. Holzhausen, Wien, pp 108–283

Reynard PC (2010) Reaching for a natural authority: the Rhône in eighteenth-century Lyon. In: Bruce SG (ed) Ecologies and economies in medieval and early modern Europe: studies in environmental history for Richard C. Hoffmann, Brill, pp 165–192

Schmeltzl W (1548) Ein Lobspruch der Hochlöblichen weitberümbten Khünigklichen Stat Wien in Osterreich, wölche wider den Tyrannen vnd Erbfeindt Christi nit die wenigist, sondern die höchst Hauptbefestigung der Christenhait ist, Rö. Khü. May. & c. vnserm aller genedigsten Herrn zu Ehren beschriben/durch Wolffgang Schmeltzl,…, reprint from 1849, Kuppitsch, Vienna

Smital H (1903) Geschichte der Großgemeinde Floridsdorf umfassend die Orte Floridsdorf, Jedlesee, Donaufeld und das Jedlersdorfer Fabriksgebiet, Community Floridsdorf, Austria
Sonnlechner C (2012) Das Wiener Rathaus als umwelthistorischer Erinnerungsort. In: Pils S, Scheutz M, Sonnlechner C, Spevak S (eds) Rathäuser als multifunktionale Räume der Repräsentation, der Parteiungen und des Geheimnisses. Forschungen und Beiträge zur Wiener Stadtgeschichte 55:255–270
Thiel V (1903) Geschichte der älteren Donauregulierungsarbeiten bei Wien I. Von den ältesten Nachrichten bis zum Beginn des 18. Jahrhunderts. Jahrb Landeskd Niederösterr, NF 2:117–163
Weigl A (2003) Frühneuzeitliches Bevölkerungswachstum. In: Csendes P, Opll F (eds) Wien: Geschichte einer Stadt. Vol 2: Die frühneuzeitliche Residenz (16. bis 18. Jahrhundert). Böhlau, Wien-Köln-Weimar, pp 109–131
White R (1995) The Organic machine: the remaking of the Columbia River. Hill and Wang, New York
Winiwarter V, Schmid M (eds) (2010) Umwelt Donau: eine andere Geschichte. Katalog zur Ausstellung des Niederösterreichischen Landesarchivs im ehemaligen Pfarrhof in Ardagger Markt, 5. Mai-7. November. Niederösterreichisches Landesarchiv, St. Pölten, Austria
Winiwarter V, Schmid M, Dressel G (2013): Looking at half a millennium of co-existence: the Danube in Vienna as a socio-natural site. Water Hist. doi:10.1007/s12685-013-0079-x